US-PAT-NO: 6388674

DOCUMENT-IDENTIFIER: US 6388674 B1

TITLE: Gamut mapping method and apparatus

DATE-ISSUED: May 14, 2002

US-CL-CURRENT: 345/590, 345/589 , 345/591 , 345/600 , 358/519 , 358/520 , 382/166 , 382/167

APPL-NO: 09/ 315978

DATE FILED: May 21, 1999

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	10-148131	May 28, 1998

---------- KWIC ---------

Brief Summary Text - BSTX (16):

It is generally said that the **gamut mapping** should preferably be done in a two-dimensional plane of the **lightness** L* and **chroma** C* in the CIE/L*C*h space while the hue h is being maintained constant. More particularly, the **gamut mapping** methods include a **chroma** compression in which only the **chroma** C* is

compressed while the **lightness** L* and hue h are being kept constant as shown in FIG. 4, a **lightness** compression in which the **lightness** L* is compressed in a direction of (L*, a*, b)=(50, 0, 0) while the hue h is being kept constant as shown in FIG. 5, and other methods. Further, for a **gamut mapping** by three-dimensional compression of the **lightness, chroma** and hue h as well, it has been proposed to weight the three color difference items (**lightness, chroma** and hue differences) (referred to as "coefficient of compressibility" hereinunder) and then map the **lightness, chroma** and hue in the direction of a minimum color difference.

Brief Summary Text - BSTX (17):

In the **gamut mapping in which the lightness or chroma** is compressed with the hue kept constant, such as the **lightness or chroma** compression, an emphasis has to be put on the compression in the direction of **lightness or chroma,** which causes the following problems:

Brief Summary Text - BSTX (19):

To prevent the above as much as possible, the compressions in the direction of lightness L* and C* should be done at reduced ratios, respectively, in a **gamut mapping** in which the hue h is somewhat changed. To solve this problem, the Inventor of the present invention has disclosed, in the Japanese Published Unexamined Patent Application No. 08-238760, a **gamut mapping** method in which

coefficients of compressibility are assigned to the **lightness, chroma** and hue differences, respectively, by weighting. This **gamut mapping** method permits to compress the **lightness** L*, **chroma** C* and hue h in a good balance. However, all data outside the **gamut are mapped over the gamut with a result that colors compressed** in a same direction are all mapped in a same color, so that they lose the gradation.

Brief Summary Text - BSTX (22):

The above object can be attained by providing a color mapping method of changing, when an output color gamut is different from an input color gamut, the input color gamut to the output color **gamut by correcting** the color using a predetermined function for a difference in the **lightness**-directional dynamic range and correcting the color by a combination of a three-dimensional compression of **lightness, chroma** and hue and a two-dimensional shrinkage or expansion of the **lightness and chroma**.

Brief Summary Text - BSTX (24):

The above object can also be attained by providing a color mapping apparatus comprising a color mapping means for changing, when an output color gamut is different from an input color gamut, a color in the input color gamut to one in the output color **gamut by using a color mapping** table created by correcting the color using a predetermined function for a difference in the

lightness-directional dynamic range, and then correcting the color by a combination of a three-dimensional compression of **lightness, chroma** and hue and a two-dimensional shrinkage or expansion of the **lightness and chroma**.

Brief Summary Text - BSTX (26):
The Invention of the present invention has proposed a two-dimensional compression of **lightness and chroma** (as in the Japanese Published Unexamined Patent Application No. 09-098298) and a three-dimensional compression of **lightness, chroma** and hue (as in the Japanese Published Unexamined Patent Application No. 08-238760). In the two-dimensional **gamut compression,** a consideration is given to the gradation in a high chroma area. The three-dimensional **gamut compression** permits to prevent the contrast of a picture from being lowered and keeps the picture vivid for a third dimension.

Detailed Description Text - DETX (17):
In the **gamut mapping** at step S4, first a color correction is done using a function such as an exponential function to correct a lightness-directional difference. Then, a color correction is done by a combination of a three-dimensional compression of **lightness, chroma** and hue and a twq-dimensional compression of **lightness** and hue. The one-, two- and three-dimensional compressions will be described in the following:

Detailed Description Text - DETX (25):
Two-dimensional **Compression: Gamut Mapping for Lightness and Chroma**

Detailed Description Text - DETX (45):
The algorithm employed in the **gamut mapping** method according to the present invention is such that the three terms (**lightness, chroma** and hue differences) in the ordinary color difference formula are weighted (the weighting factors are referred to as "coefficient of compressibility" hereinunder) for **gamut compression** in a direction in which each color difference is minimized. Namely, it is an algorithm for such a color that when the following formula (4) is used to estimate the color differences, the difference .DELTA.E is minimized.

Detailed Description Text - DETX (63):
The **gamut mapping** method having been described in the foregoing transforms a color of a picture to a color signal for each of the weighted three terms in the color difference formula (**lightness** difference .DELTA.L*, **chroma** difference .DELTA.C*.sub.ab and hue difference .DELTA.H*.sub.ab) to be minimum, thereby permitting to fully keep the characteristics such as contrast, third dimension and vividness of a picture. Also, the method divides a picture into two areas of **lightness and chroma** with the hue kept constant and compresses each area

optimally, thereby permitting to maintain the gradation in an area having a large **chroma**. Furthermore, the method corrects a lightness-directional deviation between the input and output devices, thereby permitting to prevent a black compression or the like from taking place and keep the gradation of a picture at a low lightness. Thus, the color gamut of the output device can be used to the full extent.

Detailed Description Text - DETX (65):

As having been described in the foregoing, the present invention provides a **gamut mapping** method of changing, when an output color gamut is different from an input color gamut, the input color gamut to the output color **gamut by correcting** the color with a predetermined function for a difference in the **lightness**-directional dynamic range, and correcting the color by a combination of a three-dimensional compression of **lightness, chroma** and hue and a two-dimensional shrinkage or expansion of the **lightness and chroma**. Therefore, even when a color signal outside the output color gamut smaller than the input color **gamut is supplied, the gamut mapping** method according to the present invention can transform the input color signal to the output color gamut while fully keeping the characteristics such as contrast, third dimension and vividness of a picture. Therefore, the present invention permits to provide an output device such as a printer, and so forth, capable of a natural color

reproduction at different types of devices in a
picture input/output system
such as DTP, and so forth.

Claims Text - CLTX (17):

a color mapping means for changing, when an output color gamut is different from an input color gamut, a color in the input color gamut to one in the output color **gamut by using a color mapping** table, said color mapping table created by using a predetermined function for a difference in the **lightness**-directional dynamic range, and then combining a three-dimensional compression of **lightness, chroma** and hue and a two-dimensional shrinkage or expansion of the **lightness and chroma,** wherein said means includes means for dividing the input gamut by four with a first straight line passing through a minimum value point L*min of the **lightness** L* in the output gamut and a second straight line passing through a maximum value point L*max of the **lightness** L* in the output gamut, these first and second straight lines intersecting each other at a point (C*th, L*_th) of the **lightness** value L*_th having a maximum **chroma** value C*_max of the output gamut in a two-dimensional plane of the **lightness** L* and **chroma** C* with the hue kept constant, thereby defining an area A above the first straight line and below the second straight line, an input area B other than the area A and corresponding to the output color gamut, an input area C other than an area corresponding to the output color gamut, and an

area D other than the output and input color gamuts.

US-PAT-NO: 5317426

DOCUMENT-IDENTIFIER: US 5317426 A
See image for Certificate of Correction

TITLE: Color estimation method for expanding a color image for reproduction in a different color gamut

DATE-ISSUED: May 31, 1994

US-CL-CURRENT: 358/515, 358/501 , 358/518 , 358/519 , 358/520

APPL-NO: 07/ 796251

DATE FILED: November 22, 1991

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	2-321687	November 26, 1990
JP	2-321688	November 26, 1990

---------- KWIC ---------

Abstract Text - ABTX (1):
The invention provides a method of transforming a color image data of a first media (color hardcopy) so as to be reproduced by a second media (color CRT), the color reproducing capabiity of which is

larger than that of the first
media. The **chroma** of color image data "T" is compared with a threshold value which is "a" (a <1.0) times of the maximum **chroma** of the first color **gamut** of the first media at the **lightness** "LT" and the hue ".theta.T" of the color image data "T". The chroma "rT" is enlarge in accordance with the comparison result without changing the hue ".theta.T".

Brief Summary Text - BSTX (10):

For example, in the conventional method for moving **chroma** to a high **chroma** side with the hue fixed after enlargement operation to match the maximum and minimum of **lightness,** there are problems imposed such that the movement distance is determined according to the external form of the color **gamut,** and the hue is always fixed and the **chroma** is unbalanced during movement.

Brief Summary Text - BSTX (21):

u* and v* or a* and b* among the values of the colorimetric system obtained for an optional combination of the input color component image information are not corrected when that **chroma** is smaller than a value which is "a" (a<1.0) times of the maximum **chroma** value of the input side color **gamut** on the straight line passing the **lightness and chroma** at the hue. When the chroma is larger than the abovementioned value which is "a" times of the maximum chroma value of the input side color gamut on the above straight line, u* and v* or a* and b*

are converted so that, while the hue is fixed, the chroma is converted according to the ratio of the difference between the maximum chroma value on the above straight line of the input side color gamut and the abovementioned value which is "a" times of the maximum chroma on the above straight line of the input side color gamut to the difference between the maximum chroma value on the above straight line of the output side color gamut and the abovementioned value which is "a" times of the maximum chroma of the input side color gamut.

Brief Summary Text - BSTX (27):

A combination of output color component image information can be obtained in correspondence with the enlarged and mapped colorimetric system value. Therefore, the obtained color reproduction by the output color component image information covers the entire output color reproduction **gamut** naturally and provides a sufficient **lightness or chroma** range.

Brief Summary Text - BSTX (29):

According to another invention to attain the first object of the invention, u* and v* or a* and b* among the values of the colorimetric system obtained for an optional combination of the input color component image information are not corrected when the **chroma** is smaller than a value which is "a" (a<1.0) times of the maximum **chroma** value at the hue and **lightness** of the input side color

gamut. When the **chroma** is larger than the above mentioned value, u* and v* or a* and b* are converted so that to the area enclosed by the inner color **gamut** surface which comprises a value which is "a" times of the maximum **chroma** value at each hue and **lightness** of the input side color **gamut** and the outer surface of the input side color **gamut** which comprises the maximum **chroma** value at each hue and **lightness** of the input side color **gamut**, the entire area enclosed with the above mentioned inner surface of the input side color **gamut** and the outer surface of the output side color **gamut** which comprises the maximum **chroma** value at each hue and **lightness** of the output side color **gamut** corresponds continuously.

Brief Summary Text - BSTX (33):

By doing this, the color reproduction **gamut** on the input side is included in the color reproduction **gamut** on the output side by natural conversion with the entire **chroma** balance kept, the color reproduction obtained by the output color component image information provides satisfactory **lightness and chroma, and the chroma** is well balanced as a whole.

Detailed Description Text - DETX (81):

Values wherein only values of combinations for the outer surface of the color **gamut** are converted to **lightness** L*, **chroma** r, and hue .theta. are used. There are 8 surfaces which constitute the outer

surface of the color gamut,
where the values of Y', M', and C' or R, G, and B are all 0 or maximum. The lattice point containing the hue .theta. and lightness L* is searched for, and the maximum chroma value is obtained from the chroma values at 4 peripheral points by weight average.

Detailed Description Text - DETX (200):
By doing this, the color reproduction **gamut** of printed matter is expanded to the color reproduction **gamut** of the color CRT by a natural conversion result, and the color reproduction obtained by a combination of R, G, and B provides satisfactory and natural **lightness and chroma**. In this example, for example, in a high or low lightness area, the slope of the straight line is positive or negative and the increase amount of chroma is suppressed when the chroma is increased and mapped, and hence excessive increase in only colors caused by enlarging and mapping, which causes color reproduction to be unnatural, can be suppressed.

Detailed Description Text - DETX (209):
When the chroma of the input side color gamut is enlarged and mapped, the hue is moved so that the peak of each color of the input side color gamut moves toward the peak of the corresponding color of the output side color gamut. Therefore, the color reproduction **gamut** on the input side is expanded to the color reproduction **gamut** on the output side by

natural conversion with the
entire **chroma** balance kept, the color reproduction
obtained by the output color
component image information provides satisfactory
lightness and chroma, and the
chroma is well balanced as a whole.

Claims Text - CLTX (23):
comparing a **chroma** "rT" of the color image data
"T" of the first media with
a threshold value which is "a" (a<1.0) times the
maximum **chroma** "rlmax" of
the first color **gamut at a lightness** "LT" and a hue
".theta.T" of the color
image data "T"; and

Claims Text - CLTX (27):
assuming a first region enclosed between an
inner **gamut** surface comprising a
value which is "a"(a<1.0) times the maximum
chroma of each of hue and
lightness of the first color **gamut** and the outer
surface of the first color
gamut including the maximum **chroma** of each of the
hue and the **lightness** of the
first color **gamut,** and a second region enclosed
between said inner **gamut**
surface and the outer surface of the second color
gamut which comprises the
maximum **chroma** value of each of hue and **lightness**
of the second color **gamut,**
and

US-PAT-NO: 6301383

DOCUMENT-IDENTIFIER: US 6301383 B1
See image for Certificate of Correction

TITLE: Image processing apparatus and method

DATE-ISSUED: October 9, 2001

US-CL-CURRENT: 382/162, 358/518 , 358/520 , 382/167

APPL-NO: 08/ 925678

DATE FILED: September 9, 1997

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	8-238760	September 10, 1996

---------- KWIC ---------

Brief Summary Text - BSTX (14):

The **gamut mapping** is performed in a color space which does not depend on a device, and is normally performed, particularly in a CIE/L*C*h color space (color space formed by converting an L*a*b* color space to polar coordinates) corresponding to human visual characteristics. In the CIE/L*C*h, L*, C* and h

represent **lightness, chroma** and hue, respectively.

Brief Summary Text - BSTX (15):

Conventionally, when **gamut mapping** is performed, hue is fixed in a CIE/L*C*h color space, and **lightness and chroma** are compressed on a two-dimensional plane comprising **lightness and chroma**.

Brief Summary Text - BSTX (17):

According to the above-described method in which **gamut mapping** is performed while fixing hue, **lightness or chroma** is greatly compressed, problems occur because compression of **lightness** decreases contrast and a stereoscopic effect of an image, and a deterioration in **chroma** decreases brightness to form an image from which an impression cannot be made.

US-PAT-NO: 5991511

DOCUMENT-IDENTIFIER: US 5991511 A

TITLE: Appearance-based technique for rendering colors on an output device

DATE-ISSUED: November 23, 1999

US-CL-CURRENT: 358/1.9, 358/1.1 , 358/518 , 358/520 , 358/523 , 382/162 , 382/167

APPL-NO: 08/ 871487

DATE FILED: June 9, 1997

PARENT-CASE:

This application is a continuation of U.S. application Ser. No. 08/595,404, filed Feb. 5, 1996, now U.S. Pat. No. 5,650,942, which claims priority from U.S. Provisional Application No. 60/011,064, filed Feb. 2, 1996, the entire disclosures of which are hereby incorporated by reference.

---------- KWIC ---------

Drawing Description Text - DRTX (13):

FIG. 12 is a V-T-D plot showing **gamut mapping** for an out-of-**chroma** and

out-of-**lightness** situation;

Detailed Description Text - DETX (47):
As mentioned above, the **gamut mapping or gamut compression** problem arises when the target output device is incapable of rendering every color that is specified in the input image. The problem is similar to that of sweeping dirt under a rug. The lump in the rug (the mapping error) needs to be hidden in some dark corner out of sight, while presenting to the casual visitor the appearance of a properly cleaned house. As will be seen in connection with the discussion below, the invention seeks to preserve **lightness** (where possible) and hue, while reducing **chroma** if necessary to achieve excellent appearance.

Detailed Description Text - DETX (48):
FIG. 10 is a V-T-D plot showing **gamut mapping** for an out-of-**lightness** situation, i.e., a situation where the color to be rendered has a **lightness** (V value) that is too large for the printer to render at the pixel's **chroma** (r value). Put another way, the pixel designated 130 is above the umbrella surface (the projection in the plane being line 60), but within the maximum chroma limit (defined by maximum chroma line 65). This is shown schematically as the pixel defining a vector 135 that intersects line 60 at a point 140. This manifests itself in the pixel's specified V.sub.pix being greater than V.sub.top for the pixel's r and .theta.

coordinates, i.e., V.sub.top for point 140.

Detailed Description Text - DETX (52):

FIG. 11 is a V-T-D plot showing **gamut mapping** for an out-of**-chroma** situation, i.e., a situation where the color to be rendered for a pixel 150 has a **chroma** (r value) that is too large for the printer to render at the pixel's **lightness** (V value). Put another way, the pixel is outside the maximum chroma limit, but still below the umbrella surface (as extended downwardly past the border point).

Detailed Description Text - DETX (54):

FIG. 12 is a V-T-D plot showing **gamut mapping** for a pixel 160 presenting an out-of**-chroma** and out-of**-lightness** situation. This situation is handled in the same manner as the out-of**-lightness** but within **chroma** situation discussed above. Pixel 160 is mapped to a point on the umbrella surface that has the same lightness. Again, the darkness is 0.

system is smaller than that of
the input system, the gamut of the input system is divided into four portions
in a two-dimensional plane of **lightness and chroma,** under a constant color hue,
using two straight line segments, and **gamut compression** is done by varying the
compressing direction from one area to another, for converting the color in the
gamut of the input system into the color in the gamut of the output system.

Detailed Description Text - DETX (7):
That is, the color **gamut compression** processor 32 divides the gamut GMin of
the input system for the color picture data of the CIE/L* C* into four
portions, in the two-dimensional plane of the **lightness** L* and **chroma** C*, under
the constant color phase h, using two straight line segments, as shown in FIG.
8.

Detailed Description Text - DETX (51):
The visual sense test was conducted using two sorts of CG images, that is a
first image CG1 containing large amounts of yellow and green and a second image
CG2 containing large amounts of blue and magenta. As the techniques for **gamut
compression,** the conventional methods, that is the **chroma** compression (A),
lightness compression (B) and the minimum color difference method(C), and the
technique shown in FIG. 10 wherein K=0(D), K
0.75(E) and K=1(F), were used. In
a dark room not affected by extraneous light, a monitor and a light box were

placed in a 90. position centered about 33 panelists of which 19 were male and 14 were female. Two images of different **gamut compression** techniques, presented on the light box, and an image in the monitor, were presented for comparison to 33 panelists, who were then asked to judge which of the two images were more alike the image on the monitor for all combinations (6.times.5/2=15 combinations). For the images presented in the light box, an output image of an ink jet printer (A3+, 300 DPI, continuous system) and an output image of a sublimation type printer (A4, 163DPI) were used.

Detailed Description Text - DETX (54):

With the **gamut compression method of the present invention, if the gamut** of the output system is smaller than that of the input system, the gamut of the input system is divided into four portions in a two-dimensional plane of **lightness and chroma,** under a constant color hue, using two straight line segments, and **gamut compression** is done by varying the compressing direction for each area, for converting the color in the gamut of the input system into the color in the gamut of the output system, so that **gamut compression** can be done for realization of a more natural-looking image.

Detailed Description Text - DETX (56):

With the **gamut compression** method according to the present invention, in

which, in a two-dimensional plane of **lightness** L* and **chroma** C* of color
picture data in the CIE/L* C* h color space, under a constant color phase h,
the color of the input system is divided into four areas by a first straight
line segment traversing the minimum value L*.sub.-- min of **lightness** L* of the
gamut of the output system and a second straight line segment traversing the
maximum value L*.sub.-- max of **lightness** L* of the gamut of the output system
and intersecting the first straight line segment at a point (C*.sub.-- th, L*
th) on a **lightness** value L*.sub.-- th having the maximum **chroma** value of
C*.sub.-- max in the gamut of the output system, wherein the color of the first
area above said first straight line segment and below the second straight line
segment is left as is, the color of the second area lying above the first and
second straight line segments is compressed in the direction of a point (0,
L*.sub.-- min), the color of the third area lying below the first and second
straight line segments is compressed in the direction of a point (0, L*.sub.--
max) and the color of the fourth area lying below the first straight line
segment and above the second straight line segment is compressed in the
direction of a point (C*.sub.-- th, L*.sub.-- th), compression may be achieved
in such a manner that **chroma** will be maintained as far as possible in the high
lightness area, that is in the second area, and in the low **lightness** area, that
is in the third area, and in such a manner that gradation will be maintained to

a certain extent in the high **chroma** area, that is in the fourth area.

Detailed Description Text - DETX (57):
Moreover, with the **gamut compression** method according to the present invention, in which the point (C*.sub.-- th, L*.sub.-- th) is moved by a parameter K given by C*.sub.-- th=C*.sub.-- max.times.K, where 0.ltoreq.K .ltoreq.1, the gradients of the first and second line segments can be varied for setting the compressing direction from one area to another. In addition, the lowering in the **chroma** direction may be minimized by increasing the parameter K, while the variation in the **lightness** direction may be reduced and gradation in the high **chroma** area may be improved by decreasing the value of K.

Detailed Description Text - DETX (62):
where the maximum values of the gamut of the input system and the output system on a straight line segment traversing two points of (L*.sub.-- th, C*.sub.-- th, h.sub.-- in), (L*.sub.-- in, C*.sub.-- in, h.sub.-- in) are (L*.sub.-- m, C* m, h.sub.-- in) and (L*.sub.-- p, C*.sub.-- p'h.sub.-- in). The result is that compression may be achieved in such a manner that **chroma** will be maintained as far as possible in the high **lightness** area, that is in the second area, and in the low **lightness** area, that is in the third area, and in such a manner that gradation will be maintained to a certain extent in the

high **chroma** area, that is in the fourth area. Moreover, there is no discontinuity in the threshold area produced by area division. Thus, for a color DPT system, **gamut compression** can be done in the CIE/L* C* h color space as the common color space while color reproducibility is maintained.

Detailed Description Text - DETX (77):

where the maximum values of the gamut of the output system for an area outside the gamut of the output system on a straight line segment traversing two points (L*.sub.-- th, C*.sub.-- th, h.sub.-- in), (L*.sub.-- in, C* in, h.sub.-- in) are (L*.sub.-- p, C*.sub.-- p, h.sub.-- in). The result is that compression may be achieved in such a manner that **chroma** will be maintained as far as possible in the high **lightness** area, that is in the second area, and in the low **lightness** area, that is in the third area, and in such a manner that gradation will be maintained to a certain extent in the high **chroma** area, that is in the fourth area. Moreover, there is no discontinuity in the threshold area produced by area division. Thus, for a color DPT system, **gamut compression** can be done in the CIE/L* C* h color space as the common color space while color reproducibility is maintained.

Detailed Description Text - DETX (78):

A **gamut compression** apparatus according to the present invention has area discrimination means for discriminating to which

one of four areas obtained when dividing the gamut of an input system in a two-dimensional plane of **lightness and chroma** under a constant color phase, using two straight line segments, belongs an input color picture, and **gamut compression means for carrying out gamut compression** of converting the color outside the gamut of an output system into the color inside the **gamut of the output system as the compressing** direction is varied from area to area based on area discrimination by said area discrimination means. The result is that the colors in the gamut of the input system can be converted into those in the gamut of the output system, in case the gamut of the output system is smaller than that of the input system, by way of **gamut compression,** in such a manner as to produce a more natural-looking image.

Detailed Description Text - DETX (79):

With the **gamut compression** apparatus according to the present invention, the area discrimination means judges to which of the four areas of the gamut of the input system divided by a first straight line segment traversing the minimum value L*.sub.-- min of **lightness** L* of the gamut of the output system and a second straight line segment traversing the maximum value L*.sub.-- max of **lightness** L* of the gamut of the output system, intersecting the first straight line segment at a point (C*.sub.-- th, L*.sub.-- th) on a **lightness** value L*.sub.-- th having the maximum **chroma** value of

C*.sub.-- max in the gamut of
the output system, belongs color data of the CIE/L* C* h color space in a
two-dimensional plane of **lightness** L* and **chroma** C*, under a constant color
phase h, wherein the **gamut compression means carries out gamut compression**
based on the results of discrimination by the area discriminating means so that
the color of the first area above the first straight line segment and below the
second straight line segment is left as is, the color of the second area lying
above the first and second straight line segments is compressed in the
direction of a point (0, L*.sub.-- min), the color of the third area lying
below the first and second straight line segments is compressed in the
direction of a point (0, L*.sub.-- max) and the color of the fourth area lying
below the first straight line segment and above the second straight line
segment is compressed in the direction of a point (C*.sub.-- th, L*.sub.-- th).
The result is that compression may be achieved in such a manner that **chroma**
will be maintained as far as possible in the high **lightness** area, that is in
the second area, and in the low **lightness** area, that is in the third area, and
in such a manner that gradation will be maintained to a certain extent in the
high **chroma** area, that is in the fourth area.

Detailed Description Text - DETX (85):

where the maximum values of the gamut of the input system and the output
system on a straight line traversing two points of

(L*.sub.-- th, C*.sub.-- th,
h.sub.-- in), (L*.sub.-- in, C*.sub.-- in, h.sub.--
in) are (L*.sub.-- m,
C*.sub.-- m, h.sub.-- in) and (L*.sub.-- p,
C*.sub.-- p, h.sub.-- in). The
result is that compression may be achieved in such
a manner that **chroma** will be
maintained as far as possible in the high **lightness**
area, that is in the second
area, and in the low **lightness** area, that is in the
third area, and in such a
manner that gradation will be maintained to a
certain extent in the high **chroma**
area, that is in the fourth area. Moreover, there
is no discontinuity in the
threshold area produced by area division. Thus,
for a color DPT system, **gamut**
compression can be done in the CIE/L* C* h color
space as the common color
space while color reproducibility is maintained.
With the **gamut compression**
apparatus according to the present invention, the
value of the color picture
data prior to **gamut compression** is set to (L* in,
C*.sub.-- in, h.sub.-- in),
and the value of the color picture data subsequent
to **gamut compression** is set
to (L*.sub.-- out, C*.sub.-- out, h out),
compression is done in the second
area in a direction of a point (L*.sub.-- min, 0,
h.sub.-- in) which will give

Detailed Description Text - DETX (99):
where the maximum values of the gamut of the
output system for an area
outside the gamut of the output system on a
straight line segment traversing
two points (L*.sub.-- th, C*.sub.-- th, h.sub.--
in), (L*.sub.-- in, C* in,

h.sub.-- in) are (L*.sub.-- p, C*.sub.-- p, h.sub.-- in). The result is that compression may be achieved in such a manner that **chroma** will be maintained as far as possible in the high **lightness** area, that is in the second area, and in the low **lightness** area, that is in the third area, and in such a manner that gradation will be maintained to a certain extent in the high **chroma** area, that is in the fourth area. Moreover, there is no discontinuity in the threshold area produced by area division. Thus, for a color DPT system, **gamut compression** can be done in the CIE/L* C* h color space as the common color space while color reproducibility is maintained.

Claims Text - CLTX (6):

3. The method for **gamut compression** as claimed in claim 1 wherein, in a two-dimensional plane of **lightness** L* and **chroma** C* of color picture data in the CIE/L* C* h color space, under a constant color phase h, the color of the input system is divided into four areas by a first straight line segment traversing the minimum value L*.sub.-- min of **lightness** L* of the gamut of the output system and a second straight line segment traversing the maximum value L*.sub.-- max of **lightness** L* of the gamut of the output system, said first and second straight line segments intersecting each other at a point (C*.sub.-- th, L*.sub.-- th) on a **lightness** value L*.sub.-- th having he maximum **chroma** value of C*.sub.-- max in the gamut of the output system;

Claims Text - CLTX (46):
9. The apparatus for **gamut compression** as claimed in claim 8 wherein said area discrimination means judges to which of the four areas of the gamut of the input system divided by a first straight line segment traversing the minimum value L*.sub.-- min of **lightness** L* of the gamut of the output system and a second straight line segment traversing the maximum value L*.sub.-- max of **lightness** L* of the gamut of the output system belongs color picture data in the CIE/L*C*h color space, said first and second straight line segments intersecting each other at a point (C*.sub.-- th, L*.sub.-- th) on a **lightness** value L*.sub.-- th having the maximum **chroma** value of C*.sub.-- max in the gamut of the output system, in a two-dimensional plane of **lightness** L* and **chroma** C*, under a constant color phase h; and wherein

US-PAT-NO: 6437792

DOCUMENT-IDENTIFIER: US 6437792 B1

TITLE: IMAGE PROCESSING APPARATUS AND METHOD, COLOR GAMUT CONVERSION TABLE CREATING APPARATUS AND METHOD, STORAGE MEDIUM HAVING IMAGE PROCESSING PROGRAM RECORDED THEREIN, AND STORAGE MEDIUM HAVING RECORDED THEREIN COLOR GAMUT CONVERSION TABLE CREATING PROGRAM

DATE-ISSUED: August 20, 2002

US-CL-CURRENT: 345/600, 345/590 , 345/601 , 345/603

APPL-NO: 09/ 488617

DATE FILED: January 20, 2000

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	11-014515	January 22, 1999
JP	11-200838	July 14, 1999

---------- KWIC ---------

Brief Summary Text - BSTX (19):

In the two-dimensional color gamut reduction, two of **lightness, chroma** and hue are changed. Normally in this two-dimensional color gamut reduction, the **chroma and lightness** should preferably be reduced while the hue is kept constant. For the two-dimensional color gamut reduction, various techniques have been proposed. For example, E. G. Pariser proposed to reduce the **chroma and lightness** in the direction of (L*, a*, b*)=(50, 0, 0) with the hue kept constant as shown in FIG. 7 (in his "An Investigation of Color Gamut Reduction Techniques", IS&T Symp. Elec. Prepress Tech.--Color Printing, pp. 105-107. (1991)). Also, the Japanese Unexamined Patent Application Publication No. 9-98298 has disclosed a technique that a color gamut should be divided for each hue and each divided color **gamut be mapped in an optimum color gamut** reducing direction as shown in FIG. 8.

Detailed Description Text - DETX (114):

As in the foregoing, a color signal whose ratio between the distance from the outer wall of the colorimetric area and that from the outer wall of the monitor color **gamut is m:n is mapped** along the profile of the output device imaginary color gamut whose ratio between the distance from the outer wall of the colorimetric area and that from the outer wall of the printer color gamut is x:y. The above processing is effected all the to-be-reduced input image color signals. Thus, the linear or nonlinear reduction can be adopted to

effect a color gamut reduction using the three-dimensions, namely, **lightness, chroma** and hue.

US-PAT-NO: 5991511

DOCUMENT-IDENTIFIER: US 5991511 A

TITLE: Appearance-based technique for rendering colors on an output device

DATE-ISSUED: November 23, 1999

US-CL-CURRENT: 358/1.9, 358/1.1 , 358/518 , 358/520 , 358/523 , 382/162 , 382/167

APPL-NO: 08/ 871487

DATE FILED: June 9, 1997

PARENT-CASE:

This application is a continuation of U.S. application Ser. No. 08/595,404, filed Feb. 5, 1996, now U.S. Pat. No. 5,650,942, which claims priority from U.S. Provisional Application No. 60/011,064, filed Feb. 2, 1996, the entire disclosures of which are hereby incorporated by reference.

---------- KWIC ---------

Drawing Description Text - DRTX (13):

FIG. 12 is a V-T-D plot showing **gamut mapping** for an out-of-**chroma** and

out-of-**lightness** situation;

Detailed Description Text - DETX (47):
As mentioned above, the **gamut mapping or gamut compression** problem arises when the target output device is incapable of rendering every color that is specified in the input image. The problem is similar to that of sweeping dirt under a rug. The lump in the rug (the mapping error) needs to be hidden in some dark corner out of sight, while presenting to the casual visitor the appearance of a properly cleaned house. As will be seen in connection with the discussion below, the invention seeks to preserve **lightness** (where possible) and hue, while reducing **chroma** if necessary to achieve excellent appearance.

Detailed Description Text - DETX (48):
FIG. 10 is a V-T-D plot showing **gamut mapping** for an out-of-**lightness** situation, i.e., a situation where the color to be rendered has a **lightness** (V value) that is too large for the printer to render at the pixel's **chroma** (r value). Put another way, the pixel designated 130 is above the umbrella surface (the projection in the plane being line 60), but within the maximum chroma limit (defined by maximum chroma line 65). This is shown schematically as the pixel defining a vector 135 that intersects line 60 at a point 140. This manifests itself in the pixel's specified V.sub.pix being greater than V.sub.top for the pixel's r and .theta..

coordinates, i.e., V.sub.top for point 140.

Detailed Description Text - DETX (52):

FIG. 11 is a V-T-D plot showing **gamut mapping** for an out-of**-chroma** situation, i.e., a situation where the color to be rendered for a pixel 150 has a **chroma** (r value) that is too large for the printer to render at the pixel's **lightness** (V value). Put another way, the pixel is outside the maximum chroma limit, but still below the umbrella surface (as extended downwardly past the border point).

Detailed Description Text - DETX (54):

FIG. 12 is a V-T-D plot showing **gamut mapping** for a pixel 160 presenting an out-of**-chroma** and out-of**-lightness** situation. This situation is handled in the same manner as the out-of**-lightness** but within **chroma** situation discussed above. Pixel 160 is mapped to a point on the umbrella surface that has the same lightness. Again, the darkness is 0.